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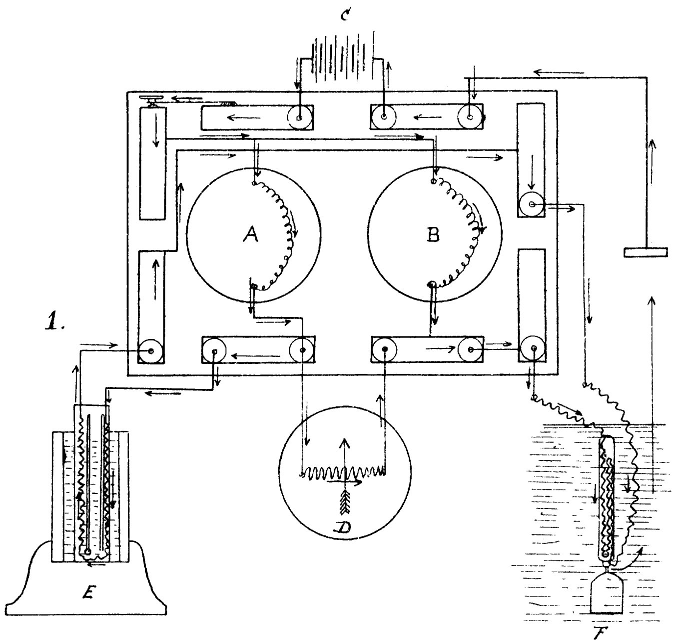

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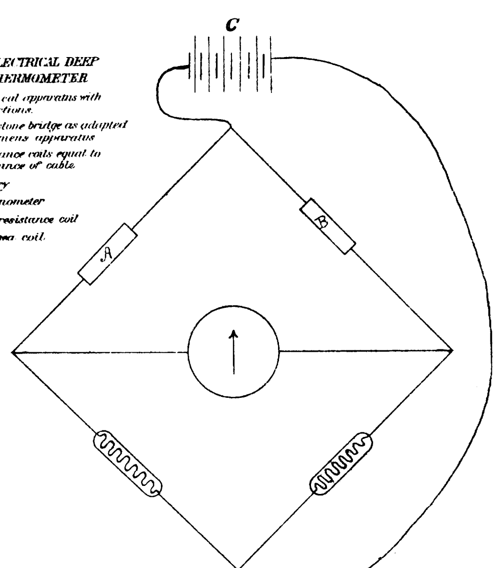

SIEMENS ELECTRICAL DEEP SEA THERMOMETER

- 1 Electrical apparatus with connections.
- 2 Wheatstone bridge as adapted to Siemens apparatus
- A.B Resistance coils equal to resistance of cable
- C Battery
- D Galvanometer
- E Deck resistance coil
- F Deep sea coil

THE GULF STREAM.

ADDITIONAL DATA FROM THE INVESTIGATIONS
OF THE
COAST & GEODETIC STEAMER "BLAKE,"

BY
COMMANDER J. R. BARTLETT, U. S. N.,
Assistant C. & G. Survey.

My previous paper, read before this society, told of the source of the Gulf Stream, beginning with the equatorial current at Barbadoes, and following it in its course through the Gulf of Mexico to the Straits of Florida. Our work was over entirely new and unexplored ground, and I was not hampered with any theories, nor had there been anything written on the subject.

The "Gulf Stream," that body of warm water flowing through the Straits of Florida and along our coast, which is said by many to influence the climate of England and Northern Europe, is a subject on which much has been written, each writer solving the question in a manner satisfactory to himself. I shall, therefore, treat the main subject with hesitation, merely giving my deductions from the actual facts obtained by the *Blake's* party, and, if not throwing much new light on the subject, I will endeavor, at least, to correct a few popular errors.

A President of the Royal Geographical Society once said to that body: "The Gulf Stream was almost as great a nuisance as Macaulay's New Zealander, or the German who evolves things from the depths of his consciousness. There

are certain remarks which nobody ever makes without a certain air of superior wisdom, and the man who affected familiarity with the Gulf Stream always seemed to feel himself six inches taller in consequence. I should have real pleasure in learning that the Gulf Stream had been definitely exploded.''

After being for three months engaged in crossing and recrossing the Gulf Stream from Jupiter Inlet, Florida, to Cape Hatteras, and obtaining some important facts, I am by no means familiar with this great wonder of the ocean, and will not, therefore, venture to claim the additional six inches mentioned by the learned geographer. Such facts as I have obtained I will lay before you, and in the near future hope to contribute such additional information as will make all familiar with the Gulf Stream.

The *Blake* reached Cape Canaveral May 22d, 1881. My instructions from Mr. Patterson, Superintendent of the Coast Survey, were to run lines normal to the coast every sixty miles, beginning at Jupiter Inlet, Florida, and extending to Currituck, North Carolina.

On these lines I was directed to take soundings at distances of five miles, with bottom and surface temperatures, also frequent series of temperatures at various depths. The temperature of the water from the surface to thirty fathoms was especially required to determine the bifurcation of the stream into warm and cold bands as had been previously reported. Every fact possible was to be obtained in regard to the boundaries of the stream, and every line was to be completed before beginning another. I found it more practicable to do only one class of work at a time, and, with the approval of the superintendent, con-

fined myself to soundings with bottom and surface temperatures—the serials to be carried on at another time.

I will give some account of the first lines; although they explain themselves in a study of the data given.

On May 29th we anchored a few hundred yards from Memory Rock, Little Bahama Bank, in four fathoms of water. Memory Rock is a mass of coral about one hundred feet long by fifty feet wide, its highest part being fifteen feet above the water line.

On May 30th a line of soundings was run across the stream to Florida.

To run the distance (48 miles), from the rock to Jupiter Inlet light, with the time necessary for soundings at every five miles, would take nine hours. Three miles per hour were allowed as an *average* current, and a course was steered for a point 27 miles south of Jupiter Inlet, this latter point being almost due west from our starting point.

Running by patent log 6.1 miles between soundings would bring the soundings five miles apart on the true line. We left Memory Rock so as to bring the noon position as near the centre of the stream as possible. The shore was made about two miles to the southward of Jupiter Inlet, the sea being smooth, with a light S.E. breeze. To our noon position we had a northerly current of from 1.5 to 2.7 knots per hour; from the noon position to sighting the light, the current was over five knots per hour, and thence 3, 2 and 1 knots, until we anchored. We were exactly nine hours in running the line. In addition to soundings every five miles with surface and bottom temperatures, other temperatures were taken at short intervals to a depth of thirty fathoms. Again we crossed to the Bahamas and re-

turned to Florida, these latter lines being principally for observations of temperatures. We found the same average current, but the strength in the axis of the stream was near the east or west shore, according to the direction of the wind.

The temperatures below the surface were taken with the Miller-Casella thermometers. The electric apparatus which had been placed on board before sailing, could not be used, owing to the non-arrival of an ice machine which had been ordered from France.

This line, called A, was the only one where serial temperatures were taken, it being thought best to confine our work to soundings until such time as we should be able to use the Siemens electric apparatus.

The soundings across from Memory Rock, with surface and bottom temperatures, were as follows:

At anchorage near Memory Rock, in 4 fathoms water, surface 78°, bottom 78°.

5 miles	Surface, 81½°	Depth, 294 fathoms	Bottom, 56½°
4½ "	" 81½°	" 347 "	" 52°
4½ "	" 81½°	" 395 "	" 45°
4½ "	" 82½°	" 439 "	" 44°
5½ "	" 83°	" 416 "	" 44°
5 "	" 83°	" 341 "	" 44°
5¾ "	" 82½°	" 250 "	" 50°
5 "	" 80°	" 176 "	" 50°
5¼ "	" 80°	" 95 "	" 57°
2¼ "	" 80°	" 31 "	" 71°
2¾ "	" 80°	" 10 "	" 78°

2¼ miles to shore.

The area of this cross section is 429,536,240 square feet; and, assuming the velocity at three knots, the delivery would be 51,028,905,312,000 gallons per hour.

The lines of soundings were continued to Currituck, N. C. On two occasions we crossed previous lines and obtained exactly the same depth to a fathom.

The work of the season gives very interesting data in regard to the physical features of the bottom of the ocean over which the Gulf Stream flows. Instead of a deep channel in the course of the stream, as reported by Lieuts. Maffit and Craven, and published in the Coast Survey reports by Prof. Bache, our later soundings show an extensive and nearly level plateau, extending from a point to the eastward of the Bahama Banks to Cape Hatteras; off Cape Canaveral nearly 200 miles wide and gradually contracting in width to the northward until reaching Hatteras, where the depth is more than 1,000 fathoms within 30 miles of shore. This plateau has a general depth of 400 fathoms, suddenly dropping off on its eastern edge to over 2,000 fathoms.

The soundings in the full strength of the current were all taken with the 60-pound shot sinkers, each being detached on reaching bottom. The time allowed for the sinker to reach the bottom was less than one minute to each one hundred fathoms in depth. Most of the soundings on each side of the stream, when not in the current, were taken with a 36-pound lead on the sounding wire, the lead being reeled back each time. Specimens of the bottom were obtained at nearly every sounding; the only failure was in using the lead and Stellwagen cup, in which case, while waiting for the bottom thermometer to register, the specimen was

washed out by the motion of the vessel. Enough specimens were obtained, however, to give a very good idea of the bottom where the lines were run. The course of the Gulf Stream can be traced by a study of these specimens. On each side of the stream the cylinder brought up ooze, but in the strength of the current the bottom was washed nearly bare, the specimens being small pieces of disintegrated coral rock. This bare portion was very hard, and the sharp edge of the brass cylinder came up indented and defaced. From Jupiter Inlet, with the exception of the bare part mentioned, the specimens were a light-colored ooze, composed of Pteropod shells, with a mixture of coral sand. Off Charleston, where the plateau has less depth than to the southward, the bare section extended the whole width of the stream. The Pteropod ooze extended only to Charleston. To the northward of that point the bottom specimens were Globigerina ooze, of a dark greenish color.

In the Caribbean Sea and Gulf of Mexico the bottom is always Pteropod ooze. These Pteropods are brought along by the Gulf Stream. Sir Wyville Thomson reported most of the Northern Atlantic bed to be Globigerina ooze, and as far as off the George's banks the *Blake* always found this latter. The fact of finding this ooze off Hatteras, and its gradual diminution, and at last its total absence to the southward, would tend to show the limit of the Arctic current. The Globigerina were not found anywhere on the plateau to the southward of Charleston. The Gulf Stream has for its western bank the 100-fathom curve. It has a depth of 400 fathoms as far as Charleston, where it is reduced to 300 fathoms ; but the Arctic current has for its bank the 1,000-fathom curve, which is quite close to shoal water, from the George's banks to Hatteras. These speci-

mens of the bottom seem to me to throw very important light on the circulation. From them alone we can state as a fact that the Arctic current does not extend along our coast below Hatteras; but at this point the Arctic current, with its colder and heavier waters, in following its bank the 1,000-fathom curve meets the Gulf Stream and goes under it, following the outside of the plateau towards the equator. In addition, the few temperatures that were obtained at the bottom confirm the same fact.

Many have met icebergs advancing against the Gulf Stream, carried along by their immersed section, which is in an opposite current coming from the northward. A branch of the Arctic current which brings these icebergs south, tends to the westward after rounding the Newfoundland banks and flows along our coast as far as Hatteras.

My instructions laid particular stress on the temperatures of the surface, and to five fathoms beneath it, in order to show the bifurcation of the Gulf Stream into warm and cold bands. The temperature of the surface water was taken at every mile on all lines by means of an ordinary thermometer. The water for this purpose was drawn over the stern. At every sounding the temperature of the surface was also taken forward by means of the thermometer attached to the hydrometer case, and compared with that aft. Both thermometers were compared with a standard each day.

I was furnished with a diagram, published by Prof. Bache in 1861 to accompany his report on the Gulf Stream, as a guide to me as to what I was expected to find. The surface temperatures obtained by the *Blake* do not show any bifurcation of the Gulf Stream before reaching Hat-

teras. At this latter point I only ran out a few miles, but there were indications of warm and cold bands.

The surface temperatures found in the Stream are much below those generally given by writers, the average temperature in the axis of the stream rarely exceeding 83° in June and July. On one or two occasions the thermometer read as high as 86°, and once 89°, but it was at high noon in a calm. The temperature at five fathoms did not range above the average of 81½°. An increase of temperature of the surface water was found as we entered the current, and the curve was over the higher temperature found at the bottom.

The surface temperature did not indicate a cold wall inside of the stream ; and the water inside of the 100-fathom line extending to the shore seemed to be an overflow of the stream, as the temperatures to five, ten, and fifteen fathoms were nearly as high as those found in the stream.

The temperatures at the bottom in the stream at corresponding depths were the same as those found in the Windward passage, and in the course of the current to the Yucatan passage. The average bottom temperature at 400 fathoms in the stream was 45°, and at Charleston, in 300 fathoms, 53°. The temperature at 300 fathoms off the George's bank was found in July to be 40°, and this was the temperature that I found at the same depth just north of Hatteras and of the Gulf Stream.

I have stated that I did not find a cold wall by the surface temperature, but the bottom temperatures give a narrow cold section close to the 100-fathom curve all along the course of the stream ; and soon after leaving the Straits of Florida there seems to be a division of the stream, one part

following the coast, and another branching off to the eastward. Temperatures at varying depths are now needed for a study of the stream. The results of the last work of the *Blake* may be considered as little more than giving the contour lines. In the dredgings made by the *Blake*, we have brought the tropical fauna as far north as Hatteras; but off the Chesapeake, Delaware and Narragansett Bays the specimens were strictly Arctic in the forms of life. I have no doubt in my own mind that the Gulf Stream causes the mild climate of England and the Scandinavian peninsula, and keeps open all the year round the port of Hammerfest, in Norway. I trust that our Government will continue the present investigations until we prove it.

Mr. Wm. H. Dall, Assistant U. S. C. & G. Survey, who has lately been investigating the currents in Behrings Straits, says in his report:

"The chief current of Behring Sea is a motion of cold water southward. This has a superficial stratum above it, which has in summer, when not interrupted by wind, a northerly motion of translation, but is not sufficient either in mass, motion, or consistency of direction, to be entitled to take rank as an ocean current."

Is not this southerly current the Gulf Stream, after a journey around Europe and Asia? But I am wandering a long way from my sounding ground, and must say something of the currents.

I can only give you an account of those found by the course and distance run, and the observations. The directions and velocities are, of course, only for the time we were

actually at a particular part of the stream, and under the existing circumstances of direction and force of the wind. We found that three knots per hour was the general average to allow for the whole stream; this would give a greater velocity at some central point. Between the Bahamas and Florida the average current was exactly three miles per hour, but for a distance of fifteen miles it was as high as 5.4 miles per hour. To the northward of the Bahama Banks, and to the eastward of the stream, there was a slight current setting southeast. We found the direction of the current in the stream very much affected by the wind, sometimes inclining it to the east, then to the west.

In the latter part of June we were hove to, some fifty miles east of the Gulf Stream, off Charleston, when we experienced a current of three knots per hour setting southeast, the wind blowing a gale from southwest.

The sudden rise of the plateau off Charleston, together with the meeting of the Arctic current, creates a remarkable disturbance.

In July, 1880, I reported finding a current off Charleston some fifty miles or more from the 100-fathom curve, setting southwest. When our trawl was dragging on the bottom the vessel headed northeast, and drifted over two miles an hour southwest. I found this southwest current off Charleston, and between Charleston and Cape Fear every time last summer that I crossed the stream, but I did not find it at any other point.

In the summer of 1880, we passed through a wide belt of rippling water off Charleston, and this last summer I was frequently asked by captains and pilots if in my cruising in the stream I had seen "Little Hell" off Charleston.

We crossed the stream six times in this locality under conditions of weather from a calm to a strong breeze, and always crossed (near the centre of the stream,) bands of rippling water several miles in width. It is very like the rip at the entrance to Long Island Sound.

A very striking example of the influence of the wind on the current was experienced by us off Cape Lookout. We were in mid-stream, with the current setting well to the northward, when a fresh gale came on from the N. W. The current was turned almost due east, and for twelve and a half hours we had a current of 4.9 knots per hour E. by N. The vessel was heading *west* all this time, under full steam and foresail.

At such points where we anchored off the coast in from 20 to 60 fathoms, the current cans gave a set to the northward of about 1.7 knots. Near the coast the set of the current depends entirely on the direction of the wind.

We had as a whole very good working weather, and what was especially necessary, a clear sky, though twilights, on which we principally rely, were very difficult to obtain, owing to the mist rising from the heated water of the stream. We had a few very severe squalls off Hatteras, and one gale of wind that lasted four days, during which I took a sounding while hove to under close reefed mainsail and steam in 2,480 fathoms, without any trouble whatever, which speaks well for the Sigsbee sounding machine.

Commander Sigsbee, in his book on deep-sea sounding, has given an exhaustive description of all the appliances used on the *Blake* to date, but as the Siemens deep-sea thermometer is entirely new, it will be interesting to have some account of it. Its principle is based upon the variations in electrical resistance of metals arising from changes

of temperature. We have 2,600 fathoms of double insulated cable wound on the dredging-reel; to the end of this is attached a resistance-coil, which coil is lowered to any depth required. The other ends of the insulated cable are brought to a room on the main deck and are attached to a Wheatstone bridge specially arranged for this purpose. Another resistance-coil of the same material and resistance as that lowered into the sea is likewise attached to the bridge. The latter coil has an attached thermometer and is kept in a copper vessel filled with water. A battery of twelve Leclanche's cells and a Thompson's marine galvanometer are attached to the bridge. If the resistance-coil at the end of the cable is lowered into the sea just below the surface and some of the same water is placed in the copper vessel containing the comparison-coil, and a current is sent into the bridge, the reflected pencil of light will be at zero on the scale, as under these conditions both resistance-coils are in the same temperature. If the cable is then paid out and the resistance-coil at its end reaches any depth, say 100 fathoms, where the temperature is lower, the circuit being closed, the pencil of light will be deflected to the left. Now, if cold water is added to that in the copper vessel containing the comparison-coil, with the circuit closed, until the pencil of light comes back to zero on the scale, it is assumed that the water around each coil is the same, and the reading of the attached thermometer of the comparison-coil will give the temperature at 100 fathoms, the depth to which the cable has been lowered. After taking a series of temperatures to 800 fathoms in this way, the cable was reeled in, stopping at intervals for temperatures; in this case, with circuit closed, the deflection of light was to the right, and it was necessary to raise the temperature in

the copper vessel until the light was brought to zero on the scale.

After August 10th, fearing the approach of the hurricane season, sounding work was suspended; but before returning north I made a number of trials with the Siemens apparatus. I received a Carré ice machine at Fortress Monroe and used the ice-water made by it to reduce the temperature of the deck resistance-coil. The trials were made in latitude 36° 50′ N., longitude 74° 25′ W., during a perfect calm, with smooth sea; the ship's engine not being used during the time. Under the above conditions the results of our several lowerings were very satisfactory. Having taken many thousand deep-sea temperatures with the Miller-Casella thermometers, my confidence in them was greatly strengthened when, after repeated lowerings, their readings agreed. With the Siemens apparatus readings can be taken to one-quarter of a degree. With the Miller-Casella it is hard work to decide on half a degree.

In a previous trial in the strength of the Gulf Stream, off Charleston, during moderate weather, with the vessel rolling 15°, it was found very difficult to read the galvanometer, and this could only be done when the engine was at rest. Under these trying circumstances, however, the temperature agreed with the Miller-Casella. I give an example of a single lowering off the Chesapeake.

	Depth in Fathoms.												
	Surf.	5	10	15	20	30	50	75	100	150	200	300	400
Siemens App........	76½	76½	76½	69	58	54	54½	52½	50½	46½	43½	40½	40
Miller-Casella........	76½	76½	76	68	58	54	53½	52½	50½	46½	43¼	40⅓	40

The above was taken on August 11th, and on the 12th the Siemens thermometer indicated a warm strata of water between 30 and 75 fathoms. The Miller-Casella gave only the maximum and minimum and did not indicate this. The temperature at 20 fathoms was 57° with both thermometers; at 30 fathoms, 52°; but at 50 fathoms the Siemens thermometer read 54½, while the minimum of the Miller-Casella read the same as at 30 fathoms. At 75 fathoms the Siemens read 53, the Miller-Casella still 52°; at 100 fathoms they agreed at 50½°. These observations were continued during the entire day, with always the same results. By lowering the Miller-Casella thermometer at the rate of 200 fathoms a minute to 50 fathoms, and hauling it up 30 fathoms at the same rate, the temperature would read as high as 53½°.

It is certainly very important to be able to detect underlying currents, and with this new apparatus we shall be able to do so. It is a practical and very simple means of overcoming the trouble of obtaining accurate deep-sea temperatures, and great credit is due to Mr. Siemens, of London, for its invention, and to our Coast Survey, for being willing to expend the large amount for the necessary apparatus for its trial.

I trust that I may be pardoned if I make a slight digression to state a fact in physics with which many may be familiar.

I am often asked the lowest temperature that I have found when sounding. My reply has been 35 degrees in 3,000 fathoms. I am generally told that this is impossible, as the temperature of the maximum density of water is 39½ degrees Fahr., and that if my thermometers show a lower

temperature, it must be owing entirely to pressure. If physics did not teach them differently, a single illustration from the *Blake's* soundings would prove that they were in error. In the Windward passage we found the temperature at 700 fathoms to be 39½ degrees, and the same to the northward and southward of the passage at the same depth. North of the connecting ridge, between Cuba and Haiti, the temperature gradually fell as the depth increased until, at the bottom, in 2,000 fathoms, it was 36½ degrees; but south of the ridge and within twenty miles the temperature was 39½ degrees at 2,000 fathoms. The pressure was the same in both cases.

Ganot says: "Water presents the remarkable phenomenon that when its temperature sinks it contracts up to 4 degrees Cen., or 39½ degrees Fahr.; but from that point, although the cooling continues, it expands up to the freezing point; so that 39½ degrees Fahr. represents the point of greatest contraction of water."

The above is very often quoted to me; but I find Ganot states if water contains salts or other foreign bodies, its freezing point is lowered, and that sea-water freezes at—2.5 degrees to—3 degrees Cen.

In 1833 M. Depretz determined that the temperature of the maximum density of sea-water, which contracts steadily till just above its freezing point, is—3.67 degrees Cen. or 25.4 degrees Fahr. Sir Wyville Thomson found the average temperature of the bottom of the deep sea, in temperate and tropical regions, about 0 degrees Cen., or 32 degrees Fahr., the freezing point of fresh water. In 1818 Sir John Ross found during his Arctic voyage a temperature of—3.5 Cen., 25.75 degrees Fahr., in 680 fathoms, and Thomson found it as low as—3 degrees Cen. off Greenland.

With the Siemens apparatus I found $38\frac{1}{2}$ degrees Fahr. at 800 fathoms, the Miller-Casella thermometer giving the same reading.

The Coast and Geodetic survey will continue these interesting investigations of the Gulf Stream, and it will always give me pleasure to present to you the results of the *Blake's* work.

Mr. Hilgard, the present superintendent, kindly gave me permission to use the data that I have given in this paper.

LINES OF SOUNDINGS, WITH GENERAL DATA, RUN NORM

Distance between soundings....	2¼	2¾	2¼	5¼	5	5¾	
Depth in fathoms.............	10	31	95	176	250	341	
Char. of bottom..............	fne. S.	G. Sh.		Co. S.	Co. S.	Co. S.	C
Surface temp.................	80°	80°	80°	80°	82½°	83°	
Bottom temp..................	78°	71°	57°	50°	50°	44°	
Current......................		N 1	N 2	N 3	N 5.4	N 5.4	I

Distance between soundings....	11	10	13	4¾	5	5	4
Depth in fathoms	10	20	84	158	231	321	
Char. of bottom.			gr. S.	fne. S.	fne. S.	Co. S.	
Surface temp....			80°	80°	80½°	81°	
Bottom temp..................			57°	52°	46½°	44½°	
Current			N 2	N 2	N 2.5	N 2.5	NN

Distance between soundings ...	10	10	5	13½	4½	4½	
Depth in fathoms	10	15	25	77	173	265	4
Char. of bottom..............					Co. S.	Co. S.	C
Surface temp.................				80°	80°	80°	
Bottom temp..................				59°	49°	44½°	
Current...............				NxE 2.5	NxE 2.5	NxE 2.5	N

Distance between soundings....	3½	25½	9¼	8¾	4⅞	4½	2
Depth in fathoms	10	13	18	27	42	225	
Char. of bottom..............			brk. Sh.	brk. Sh.	crs. S., brk. Sh.	crs. S., brk. Sh.	fn
Surface temp...		80°	80°	82°	82°	83°	
Bottom temp..................		74°	70°	64½°	55½°	43°	4
Current......................				NW 1	NW 1.5	NW 1.5	N

Distance between soundings....	19	15	29½	2¼	5½	4¾	
Depth in fathoms.............	10	15	28	47	141	195	
Char. of bottom..............						Co. bk. S.	C
Surface temp.........			82°	82°	83°	83½°	
Bottom temp..................			68°	66½	47°	46½°	
Current......................				NNE 2.7	NNE 2.7	NNE 2.7	NN

Distance between soundings....	20	19½	8½	8½	5⅞	5⅞	
Depth in fathoms.............	10	18	21	20	31	53	1
Char. of bottom............ ..			G.	G.	S. brk. Sh.	bk. wh. G.	
Surface temp.................		79°	79°	79½°	80½°	81½°	
Bottom temp..................		74½°	70½°	67°	67°	63½°	
Current		O.	O.	NNE 1	NNE 1	NNE 1	N

Distance between soundings....	18	15	6	5½	7	5½	
Depth in fathoms.............	10	20	25	75	142	225	2
Char. of bottom..............							
Surface temp.................							
Bottom temp..................							
Current.........							

Distance between soundings....	15	17	20½	7	7	7	
Depth in fathoms.	10	15	19	32	70	111	1
Char. of bottom..............			crs. yl. S. bk. sp.	G. sh.	wh. bk. rd. S.	gn. S.	
Surface temp.			80°	80°	80°	80½°	
Bottom temp..................			73°	69°	60°	54°	
Current......................			NE 0.4	SE 1.5	SE 1.5	SE 1.5	

Distance between soundings....	13	15¼	10¾	10¾	7	3¾	
Depth in fathoms	10	17	19	20	21	54	

NORMAL TO THE COAST AND ACROSS THE GULF STREAM, FRO

Commander J. R. Bartlett, U. S. Nav

LINE A.—FROM JUPITER INLET, FLA., TO M

5¾ 1 S. 3° 4° 5.4	5 416 Co. S. 83½° 44° N 5.4	5½ 439 Ptd. oz. 82½° 44° N 2.7	4¼ 395 Co. S. 81½° 45° N 1.25	4½ 347 Co. 81½° 52° N 1.25	4¼ 294 Co. 81½° 56½° N 1.25	4½ 67 Co. 80°	½ 4 Co. 78° 78° Var.		

LINE B.—FROM SHORE, LATITUDE 27° 57′ N

5 S. 1° 4½° .5	4½ 446 Co. 81° 42½° NNW 3.5	4 426 Co. 81¼° 44½° NNW 4	3⅛ 387 Co. 81¼° 46½° NNW 4	4⅝ 394 Co. 82° 47½° N 3	5¼ 412 Co. 82° 46° N 2	5⅛ 448 Co. S. 82° 45° N 1,5	5¾ 466 Co. S. 82° 44° O.	6 497 Co. S. 81° 44° S. 0.5	Pt [☞

LINE C.—FROM SHORE, LATITUDE 28° 40′ N.

4½ 5 S. 0° 4½° 2.5	4½ 425 Co. S. 81° 42½° NxE 2.5	4½ 464 Co. 81° 42½° NxE 2.5	4¾ 459 Co. S. 81½° 43½° NxE 3	4½ 465 Ptd. oz. 81½° 44° NxE 3	4⅝ 466 Ptd. oz. 81¾° 44° NxE 3	4⅝ 459 Ptd. oz. 81¾° 44° NxE 2.8	4½ 456 Ptd. oz. 82° 45° N 1.5	3⅜ 458 Ptd. oz. 82° 45° N.1	P

LINE D.—FROM SHORE, LATITUDE 29° 25′ N.

4½ 5 rk.Sh. 3° 3° 1.5	4 284 fne. S. 85° 44½° NxW 2	4½ 344 Co. S. 88¾° 43° NNW 3	3½ 387 Co. 88¾° 44½° NNW 3	3¼ 415 Co. 86¾° 45¾° NNW 3	5 433 Co. 85½° 45¼° NNW 3	4¾ 457 Co. 84° 46° NNW 3	4¾ 449 Co. 84° 45° NNW 3	5⅛ 445 Co. 84° 46° NNW 3	4 [☞

LINE E.—FROM ST. JOHN'S RIVER, FLA., TO

¾ k. S. ½° ½° 2.7	4¼ 271 Co. 83¾° 45° NNE 2.7	4¼ 314 Co. S. 83¾° 44° NNE 2.7	4 375 Co. S. 83° 44° NNE 2.7	4⅛ 444 Co. S. 83° 44° NNE 2.7	4⅛ 460 Co. 83° 44° NNE 2.7	4 480 Co. 82½° 44° NNE 2.7	5¼ 480 Co. 82½° 45° N ¾ E 1.25	5¼ 467 Co. S. 82½° 45½° N ¾ E 1.25	4 C N ¾

LINE F.—FROM TYBEE ROADS, GA., TO I

⅞ n. G. ½° ° E 1	6 122 81½° 59° NNE 1	6⅛ 266 Co. 82½° 43½° NNE 1	6 265 82° 44½° NNE 2.4	5⅓ 265 Co. 82° 46½° NNE 2.4	5⅛ 260 Co. 82° 48½° N 1.5	5⅝ 320 Co. 82° 50° N 1.5	5¼ 301 Co. 83° 51° N 1.5	5⅛ 338 Co. 83° 53½° N 1.5	3 N

LINE G.—FROM CAPE ROMAN, S. C., TO I

½	5½ 217	2¾ 216	5 228 80° 45°	7 225 80° 45° E ¾ N 3.2	3½ 284 Co. S. 82° 44° E ¾ N 3.2	3½ 254 82° 45½° E ¾ N 3. 2	3¾ 349 Co. R. 82½° 44½° E ¾ N 3.2	3½ 344 Co. R. 83° 45° E ¾ N 3.2	3 C E

LINE H.—FROM SHORE, LATITUDE 33° 38′ N.

  S. ½° ° .5	4 123 Co. 81° 52° O.	4¾ 159 81½° 49° NWxW .75	5 182 wh. bk. S. 80½° 47° NWxW .75	5 224 S. G. 81° 47° NWxW .75	5½ 278 fne S. 81¼° 43° NWxW .75	6¼ 349 Co. R. 81° 44° NE ¾.E 1.7	6 377 Co. 83° 42½° NE ¾ E 1.7	6¼ 503 Co. 83½° 38½° NExE ¼ E 3.5	4 NEx

LINE I.—FROM CAPE FEAR TO LAT

¾	4¾ 92	3½ 129	3½ 164	3⅓ 184	3¼ 209	3¼ 238	2¾ 259	1⅞ 286	2

M, FROM JUPITER INLET, FLA., TO CURRITUCK, N. C., BY THE

. S. Navy, Asst U. S. C. & G. Survey.

LA., TO MEMORY ROCK, LITTLE BAHAMA BANKS.

27° 57′ N. TO LAT. 27° 51′; LONG. 77° 33′ W.

6 7 S. 1° 4° .5	4¾ 473 Ptd. oz. 79° 44½° [☞	4¼ 483 Ptd oz. 79° 44½	4⅝ 504 Ptd. oz. 79° 44°	5 516 Ptd. oz. 78° 44°	5¼ 537 Ptd. oz. 78° 43¾°	4⅝ 563 Ptd. oz. 78° 42½° South	5 582 Ptd. oz. 78° 40° erly	4½ 589 Ptd. oz. 78° 39½°	Pt

° 40′ N. TO LAT. * 28° 44′ N.; LONG. 78° 22′ W.

3⅜ 8 oz. 2° 5° 1	3⅜ 466 Ptd. oz. 81½° 45°	5⅝ 464 Ptd. oz. 80° 45°	10 478 Ptd. oz. 79° 44½° SxE 0.8	10¼ 494 Ptd. oz. 79° 43½° SxW 1	9¼ 513* Ptd. oz. 78½° 42° SSW 1.5	9¼ 528 Ptd. oz. 79° 41°			

29° 25′ N. TO LAT. 29° 31′ N.; LONG. 76° 38′ W.

5⅛ 5 . 4° 6° W 3	5⅛ 444 Co. 84° 48° [☞	5⅛ 451 Co. 83° 47°	9¼ 441 Ptd. oz. 81½° 47½°	9 448 Ptd. oz. 80½° 47½° Slight	9 459 Ptd. oz. 80¾° 47¼° current to Sd.	9 467 Ptd. oz. 80½° 43½°	10 470 Ptd. oz. 80½° 45° ☜]	10 467 Ptd. oz. 81° 43½° O.	4 Pt

FLA., TO LAT. 30° 30′ N.; LONG. 76° 44′ W.

5¼ 7 S. ° 5½° 1.25	5¼ 445 Co. S. 82½° 47° N ¾ E 1.25	5 449 Co. 82° 46½° N ¾ E 1.25	5¼ 464 Ptd. oz. 82½° 46° N ¾ E 1.25	4¼ 456 Ptd. oz. 83° 45½° N ¾ E 1.25	6¼ 453 Ptd. oz. 82° 44½° NNE 1	10¼ 456 Ptd. oz. 82½° 44° O.	10¾ 475 Ptd. oz. 84½° 45° O.	11¼ 482 Ptd. oz. 83° 47° O.	4 Pt

GA., TO LAT. 30° 51′ N.; LONG. 77° 09′ W.

5⅛ 3 . 3° 3½° .5	5¼ 385 Co. 82½° 54½° N 1.5	5 434 Ptd. oz. 82° 54½° N 1.5	5⅛ 445 Ptd. oz. 82½° 53° N 1.5	5 483 Ptd. oz. 81½° 46° N 1.5	5¼ 474 Ptd. oz. 81½° 46° N 1.5	5⅛ 474 Ptd. oz. 81½° 45° N 1.5	23⅛ 505 Ptd. oz. 81° 44½° O.	22½ 578 Ptd. oz. 81° 39½° O.	9 Pt

S. C., TO LAT. 30° 59′ N.; LONG. 77° 17′ W.

3½ 4 R. ° ° 3.2	3¾ 353 Co. R 82° 46½° E ¾ N 3,2	3½ 378 Co. 82° 48° E ¾ N 3.2	3¾ 312 Co. 82° 51½° E ¾ N 3 2	3¾ 316 Co. 82° 53° E ¾ N 3.2	3¾ 310 Co. 83° 52° ENE 2.5	4 325 Co. 83° 53° ENE 2.5	4 353 Co. 82° 54° ENE 2.5	4¼ 413 Co. S. 82° 51° ENE 2.2	4 E

3° 38′ N. TO LAT. 31° 27′ N.; LONG. 76° 00′ W.

¼ . o. ½° ½° ¼ E 3.5	6⅝ 460 Co. 83° 46° NExE ½ E 3.5	6¼ 451 Co. 83° 46° NExE ¼ E 3.5	6¼ 512 82½° 39° NExE 2.5	6 595 Co. S. 82½° 38½° NExE 1.5	6 637 Ptd. oz. 82° 38½° NExE ¼ E 1.5	6 902 Ptd. oz. 81½° 38½° NExE ¼ E 1.5	6 1241 Ptd. oz. 81½° 37° NExE ¼ E 1	35¾ 1672 Ptd. oz. 82° 36½° O.	

R TO LAT. 32° 05′ N.; LONG. 76° 09′ W.

⅞ 3	2 319	1⅞ 338	3 364	3 386	3¼ 410	3¼ 434	3¼ 459	3¼ 492	5

4½ 9 oz. 8° ½°	5¼ 584 Ptd. oz. 79° 39½°	5½ 589 Ptd. oz. 78° 39½°	5¼ 601 Ptd. oz. 78° 39°	8 609 Ptd oz. 78° 39°	5 619 Ptd. oz. 77½° 39°	5¼ 621 Ptd. oz. 78° 39° ☞]		
oz. 1° ½° .	10¼ 468 Ptd. oz. 81° 46° O.	10¼ 476 Ptd. oz. 81° 47° O.	9⅞ 498 Ptd. oz. 81½° 46½° O.	9¼ 523 Ptd. oz. 82° 45° O.	9 510 Ptd. oz. 82° 47½° O.	9½ 559 Ptd. oz. 81¼° 44½° O.	9¾ 694 Ptd. oz. 81⅓° 39¼° O.	9⅓ 2,100 Ptd. oz, 81½° 36½° O.
¼ oz. ° °	11 468 Ptd. oz. 83½° 46° O.	11¾ 464 Ptd. oz. 85¾° 46° O.	10¾ 484 Ptd. oz. 84° 45½° O.	10⅜ 585 Ptd. oz. 82° 39½° O.	9½ 1,047 Ptd. oz. 81½° 38° O.	10⅛ 1,531 Ptd. oz. 80¾° O.	10⅛ 1,638 Ptd. oz. 80¾° 36¾° O.	
½ oz. ° ½°	7½ 981 Ptd. oz. 80° 38° O.							
¼ . ° ° .2	4 438 Co. 81½° 47° ENE 2	6⅞ 458 Ptd. oz. 81½° 46° ENE 1	5⅝ 466 Ptd. oz. 81½° 46° NE ¼ E 1	7½ 499 Ptd oz. 81° 47° NE ¼ E 1	7½ 528 Ptd. oz. 81° 42½° NE ¼ N 1.3	10½ 626 Ptd. oz. 81° 39° NE ¼ N 1.3		
¾ oz. ° ½°								
¼	3 535	2⅞ 605	3½ 729	4¾ 959	4¾ 1189	9 1288	7 1351	5⅞ 1406

Distance between soundings	3½	25½	9¼	8¾	4⅞	4½	
Depth in fathoms	10	13	18	27	42	225	2
Char. of bottom			brk. Sh.	brk. Sh.	crs. S., brk. Sh.	crs. S., brk. Sh.	fn
Surface temp		80°	80°	82°	82°	83°	
Bottom temp		74°	70°	64½°	55½°	43°	4
Current				NW 1	NW 1.5	NW 1.5	N

Distance between soundings	19	15	29½	2¼	5½	4¾	
Depth in fathoms	10	15	28	47	141	195	
Char. of bottom						Co. bk. S.	C
Surface temp			82°	82°	83°	83½°	
Bottom temp			68°	66½	47°	46½°	
Current				NNE 2.7	NNE 2.7	NNE 2.7	NN

Distance between soundings	20	19½	8½	8½	5⅞	5⅞	
Depth in fathoms	10	18	21	20	31	53	1
Char. of bottom			G.	G.	S. brk. Sh.	bk. wh. G.	
Surface temp		79°	79°	79½°	80½°	81½°	
Bottom temp		74½°	70½°	67°	67°	63½°	
Current		O.	O.	NNE 1	NNE 1	NNE 1	N

Distance between soundings	18	15	6	5½	7	5½	
Depth in fathoms	10	20	25	75	142	225	2
Char. of bottom							
Surface temp							
Bottom temp							
Current							

Distance between soundings	15	17	20½	7	7	7	
Depth in fathoms	10	15	19	32	70	111	1
Char. of bottom			crs. yl. S. bk. sp.	G. sh.	wh. bk. rd. S.	gn. S.	
Surface temp			80°	80°	80°	80½°	
Bottom temp			73°	69°	60°	54°	
Current			NE 0.4	SE 1.5	SE 1.5	SE 1.5	

Distance between soundings	13	15¼	10¾	10¾	7	3¾	
Depth in fathoms	10	17	19	20	21	54	
Char. of bottom			brk. sh.	crs. S.	fne. gy. S.	S. G. brk. Sh.	
Surface temp		81°	81°	81°	82°	83°	
Bottom temp		73°	72°	66½°	66½°	63°	
Current		N. 0.4	O.	O.	O.	O.	

Distance between soundings	1½	8¼	10⅞	10	5	5	
Depth in fathoms	4½	15	19	36	107	242	5
Char. of bottom		fne. blk. S.	fne. gy. S.			brk. Sh.	Glo
Surface temp	80½°	82°	83½°	83°	84°	86°	
Bottom temp	78°	73°	76°	62°	58½°	42½°	
Current				NExN 1.75	NExN 1.73	NExN 1.75	NE

LINE K.——From Cape Hatteras to Lat. 35° 2

Distance between soundings	7½	14½	2	2	2¼	4½	
Depth in fathoms	11	36	66	303	427	1221	14
Char. of bottom				Glob. oz.	Glob. oz.	Glob. oz.	Glo
Surface temp	79°	79½°	80°	82½°	84°	84°	
Bottom temp	73°	66°	52°	41½°	40°	37½°	
Current		ENE 2.5	ENE 2.5	ENE 2.5	ENE 2.5	ENE 2.5	EN

Distance between soundings	5¾	10½	10	10¼	4⅓	4¼	
Depth in fathoms	10	16	16	21	24	24	
Char. of bottom				fne. S.		S. G. bk. Sh.	S. b
Surface temp	79°	79°	79°	77½°	77°	77°	
Bottom temp	71½°	59½°	52°	49°	46°	43°	
Current	SW 0.5	SW 0.5	SW 0.5	SW 0.5	SW 0.5	SW 0.5	S

NOTE.—THE DISTANCES BETWEEN SOUNDINGS ARE GIVEN IN NAUTICAL M

fne.—Fine. *bk.*—Black.

The first line A was ran June 1st, 1881, and they we

$\frac{1}{2}$	4	$4\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{4}$	5	$4\frac{3}{4}$	$4\frac{3}{4}$	$5\frac{1}{8}$	4
5	284	344	387	415	433	457	449	445	
rk. Sh.	fne. S.	Co. S.	Co.	Co.	Co.	Co.	Co.	Co.	
3°	85°	$88\frac{3}{4}$°	$88\frac{3}{4}$°	$86\frac{3}{4}$°	$85\frac{1}{2}$°	84°	84°	84°	
3°	$44\frac{1}{2}$°	43°	$44\frac{1}{2}$°	$45\frac{3}{4}$°	$45\frac{1}{4}$°	46°	45°	46°	
1.5	NxW 2	NNW 3	NNW 3	NNW 3	NNW 3	NNW 3	NNW 3	NNW 3	[

LINE E.——FROM ST. JOHN'S RIVER, FLA., TO

$\frac{3}{4}$	$4\frac{1}{4}$	$4\frac{1}{4}$	4	$4\frac{1}{8}$	$4\frac{1}{8}$	4	$5\frac{1}{4}$	$5\frac{1}{4}$	4
	271	314	375	444	460	480	480	467	
k. S.	Co.	Co. S.	Co. S.	Co. S.	Co.	Co.	Co.	Co. S.	C
$\frac{1}{2}$°	$83\frac{3}{4}$°	$83\frac{3}{4}$°	83°	83°	83°	$82\frac{1}{2}$°	$82\frac{1}{2}$°	$82\frac{1}{2}$°	
$\frac{1}{2}$°	45°	44°	44°	44°	44°	44°	45°	$45\frac{1}{2}$°	
2.7	NNE 2.7	NNE 2.7	NNE 2.7	NNE 2.7	NNE 2.7	NNE 2.7	N $\frac{3}{4}$ E 1.25	N $\frac{3}{4}$ E 1.25	N $\frac{3}{4}$

LINE F.——FROM TYBEE ROADS, GA., TO

$\frac{7}{8}$	6	$6\frac{1}{8}$	6	$5\frac{1}{3}$	$5\frac{1}{8}$	$5\frac{3}{8}$	$5\frac{1}{4}$	$5\frac{1}{8}$	3
	122	266	265	265	260	320	301	338	
n. G.		Co.		Co.	Co.	Co.	Co.	Co.	
$\frac{1}{2}$°	$81\frac{1}{2}$°	$82\frac{1}{2}$°	82°	82°	82°	82°	83°	83°	
°	59°	$43\frac{1}{2}$°	$44\frac{1}{2}$°	$46\frac{1}{2}$°	$48\frac{1}{2}$°	50°	51°	$53\frac{1}{2}$°	
E 1	NNE 1	NNE 1	NNE 2.4	NNE 2.4	N 1.5	N 1.5	N 1.5	N 1.5	N

LINE G.——FROM CAPE ROMAN, S. C., TO

$\frac{1}{2}$	$5\frac{1}{2}$	$2\frac{3}{4}$	5	7	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{3}{4}$	$3\frac{1}{2}$	3
	217	216	228	225	284	254	349	344	
					Co. S.		Co. R.	Co. R.	C
			80°	80°	82°	82°	$82\frac{1}{2}$°	83°	
			45°	45°	44°	$45\frac{1}{2}$°	$44\frac{1}{2}$°	45°	
				E $\frac{3}{4}$ N 3.2	E $\frac{3}{4}$ N 3.2	E $\frac{3}{4}$ N 3. 2	E $\frac{3}{4}$ N 3.2	E $\frac{3}{4}$ N 3.2	E

LINE H.——FROM SHORE, LATITUDE 33° 38′ N.

	4	$4\frac{3}{4}$	5	5	$5\frac{1}{2}$	$6\frac{1}{4}$	6	$6\frac{1}{4}$	4
	123	159	182	224	278	349	377	503	
S.	Co.		wh. bk. S.	S. G.	fne S.	Co. R.	Co.	Co.	
$\frac{1}{2}$°	81°	$81\frac{1}{2}$°	$80\frac{1}{2}$°	81°	$81\frac{1}{4}$°	81°	83°	$83\frac{1}{2}$°	
°	52°	49°	47°	47°	43°	44°	$42\frac{1}{2}$°	$38\frac{1}{2}$°	
.5	O.	NWxW .75	NWxW .75	NWxW .75	NWxW .75	NE $\frac{3}{4}$.E 1.7	NE $\frac{3}{4}$ E 1.7	NExE $\frac{1}{4}$ E 3.5	NEx

LINE I.—— FROM CAPE FEAR TO LAT

$\frac{3}{4}$	$4\frac{3}{4}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{3}$	$3\frac{1}{4}$	$3\frac{1}{4}$	$2\frac{3}{4}$	$1\frac{7}{8}$	3
	92	129	164	184	209	238	259	286	
k. Sh.			gy. S.				S.	bk. wh. S.	bk
°	$82\frac{1}{2}$°	82°	$82\frac{1}{2}$°	82°	83°	84°	$84\frac{1}{2}$″	$84\frac{1}{2}$°	
°	55°	50°	$47\frac{1}{2}$°	$45\frac{1}{2}$°	45°	45°	46°	45°	
	O.	NWxW 2.	NWxW 2.	NWxW 2.	NE $\frac{1}{2}$ N 2.	NE $\frac{1}{2}$ N 2.	NNE 5.	NNE 5.	NN

LINE J.—— FROM CAPE LOOKOUT, N. C., TO

5	4	$6\frac{5}{8}$	$11\frac{3}{4}$						
3	527	1494	2046						
Sh.	Glob. oz.	Glob. oz.	Glob. oz.						
3°	86°	85°	85°						
$\frac{1}{2}$°	39°	$37\frac{1}{2}$°	36°						
1.75	NE $\frac{1}{2}$ E 2.75	NE $\frac{1}{2}$ E 2.75	NE $\frac{1}{2}$ E 2.75						

LAT. 35° 21′ N.; LONG. 74° 20′ W.

$\frac{1}{2}$	5	$7\frac{1}{4}$	$7\frac{1}{4}$	$\frac{3}{4}$	$1\frac{3}{4}$	$1\frac{1}{4}$			
	1458	1560	1609	1643	1627	1756			
oz.	Glob. oz.	Glob. oz.	Glob. oz.	Glob. oz.	Glob. oz.	Glob. oz.			
°	84°	$84\frac{1}{2}$°	$84\frac{1}{2}$°	84°	84°	$83\frac{1}{2}$°			
$\frac{1}{2}$°	$37\frac{1}{2}$°	$37\frac{1}{2}$°	$37\frac{1}{2}$°	$37\frac{1}{2}$°	37°	$36\frac{1}{2}$°			
2.5	ENE 2.5	ExN 3.	E 4.	E 4.	E 3.	E 3.			

LINE L.——FROM CURRITUCK, N. C., TO

$\frac{1}{4}$	4	$2\frac{5}{8}$	$2\frac{1}{2}$	$2\frac{5}{8}$	$2\frac{7}{8}$	5	$4\frac{5}{8}$	5	
	51	196	536	677	749	887	1095	1165	
k. Sh.	S. brk. Sh.	fne. gn. S.	Glob. oz.	Glob. oz.	Glob. oz.	Glob. oz.	Glob. oz.	Glob. oz.	
°	$76\frac{1}{2}$°	76°	76°	76°	77°	$76\frac{1}{2}$°	76°	$76\frac{1}{8}$°	
°		42°	39°	38°	38°	$37\frac{1}{2}$°	37°	37°	
0.5	SW 0.5	SW 0.5	SW 0.5	SW 0.5	SW 0.5	SW 0.5	SW 0.5	SW 0.5	

AUTICAL MILES, THE FIRST SOUNDING BEING MEASURED FROM THE SHORE.

The Abbreviations for Chara

bk.—Black. *gy.*—Grey. *wh.*—White. *rd.*—Red. *gn.*—Green. *brk. Sh.*—Broken shells. *S.*—Sand. *G*

and they were continued to the northward during June and July. The lines were run during day and night, but we crossed the

5⅛ 5 . 4° 6° W 3	5⅛ 444 Co. 84° 48° [	5⅛ 451 Co. 83° 47°	9¼ 441 Ptd. oz. 81½° 47½°	9 448 Ptd. oz. 80½° 47½° Slight	9 459 Ptd. oz. 80¾° 47¼° current to Sd.	9 467 Ptd. oz. 80½° 43½°	10 470 Ptd. oz. 80½° 45°]	10 467 Ptd. oz. 81° 43½° O.	4 Pt

FLA., TO LAT. 30° 30′ N.; LONG. 76° 44′ W.

5¼ 7 S. ° 5½° 1.25	5¼ 445 Co. S. 82½° 47° N ¾ E 1.25	5 449 Co. 82° 46½° N ¾ E 1.25	5¼ 464 Ptd. oz. 82½° 46° N ¾ E 1.25	4¼ 456 Ptd. oz. 83° 45½° N ¾ E 1.25	6¼ 453 Ptd. oz. 82° 44½° NNE 1	10¼ 456 Ptd. oz. 82½° 44° O.	10¾ 475 Ptd. oz. 84½° 45° O.	11¼ 482 Ptd. oz. 83° 47° O.	4 Pt

GA., TO LAT. 30° 51′ N.; LONG. 77° 09′ W.

5⅛ 3 . 3° 3½° .5	5¼ 385 Co. 82½° 54½° N 1.5	5 434 Ptd. oz. 82° 54½° N 1.5	5⅛ 445 Ptd. oz. 82½° 53° N 1.5	5 483 Ptd. oz. 81½° 46° N 1.5	5¼ 474 Ptd. oz. 81½° 46° N 1.5	5⅛ 474 Ptd. oz. 81½° 45° N 1.5	23⅛ 505 Ptd. oz. 81° 44½° O.	22½ 578 Ptd. oz. 81° 39½° O.	9 Pt

S. C., TO LAT. 30° 59′ N.; LONG. 77° 17′ W.

3½ 4 R. ° ° 3.2	3¾ 353 Co. R 82° 46½° E ¾ N 3,2	3½ 378 Co. 82° 48° E ¾ N 3.2	3¾ 312 Co. 82° 51½° E ¾ N 3 2	3¾ 316 Co. 82° 53° E ¾ N 3.2	3¾ 310 Co. 83° 52° ENE 2.5	4 325 Co. 83° 53° ENE 2.5	4 353 Co. 82° 54° ENE 2.5	4¼ 413 Co. S. 82° 51° ENE 2.2	4 E

3° 38′ N. TO LAT. 31° 27′ N.; LONG. 76° 00′ W.

¼). ½° ½° ¼ E 3.5	6⅝ 460 Co. 83° 46° NExE ½ E 3.5	6¼ 451 Co. 83° 46° NExE ¼ E 3.5	6¼ 512 82½° 39° NExE 2.5	6 595 Co. S. 82½° 38½° NExE 1.5	6 637 Ptd. oz. 82° 38½° NExE ¼ E 1.5	6 902 Ptd. oz. 81½° 38½° NExE ¼ E 1.5	6 1241 Ptd. oz. 81½° 37° NExE ¼ E 1	35¾ 1672 Ptd. oz. 82° 36½° O.	

R TO LAT. 32° 05′ N.; LONG. 76° 09′ W.

⅞ 3 h. S. ½° ° E 5.	2 319 bk wh. S. 84° 44° NNE 5.	1⅞ 338 Glob. 8 ° 41° NNE 5.	3 364 Glob. 84° 42° NNE 2.5	3 386 Glob. 84° 43° NNE 2.5	3¼ 410 Glob. oz. 84° 43° NNE 2.5	3¼ 434 Glob. oz. 84° 42° NNE 2.5	3¼ 459 Glob. oz. 84° 42° NNE 2.3	3¼ 492 Glob. oz. 84° 40° NNE 2.3	5 Glo NN

N. C., TO LAT. 34° 09′ N.; LONG. 75° 22′ W.

LINE K‴.——FROM

						8½ 10	3½ 20	4 25	

. C., TO LAT. 36° 12′ N.; LONG. 74° 17′ W.

oz. ⅛° ° 0.5									

r Character of Bottom are :

Sand. *G.*—Gravel. *Sp.*—Specks. *Co.*—Coral. *Co. R.*—Coral rock. *Glob. oz.*—Globigerina ooze. *Ptd. oz.*—I

e crossed the stream in the daytime. As mentioned in the paper, the direction of the current was very much influenced by directi

oz. 1° ½° .	10¼ 468 Ptd. oz. 81° 46° O.	10¼ 476 Ptd. oz. 81° 47° O.	9⅞ 498 Ptd. oz. 81½° 46½° O.	9¼ 523 Ptd. oz. 82° 45° O.	9 510 Ptd. oz. 82° 47½° O.	9½ 559 Ptd. oz. 81¼° 44½° O.	9¾ 694 Ptd. oz. 81½° 39½° O.	9½ 2,100 Ptd. oz, 81½° 36½° O.
¼ oz. ° °	11 468 Ptd. oz. 83½° 46° O.	11¾ 464 Ptd. oz. 85¾° 46° O.	10¾ 484 Ptd. oz. 84° 45½° O.	10⅜ 585 Ptd. oz. 82° 39½° O.	9½ 1,047 Ptd. oz. 81½° 38° O.	10⅛ 1,531 Ptd. oz. 80¾° O.	10⅛ 1,638 Ptd. oz. 80¾° 36¾° O.	
½ oz. ° ½°	7½ 981 Ptd. oz. 80° 38° O.							
¼ . ° ° .2	4 438 Co. 81½° 47° ENE 2	6⅞ 458 Ptd. oz. 81½° 46° ENE 1	5⅝ 466 Ptd. oz. 81½° 46° NE ¼ E 1	7½ 499 Ptd oz. 81° 47° NE ¼ E 1	7¼ 528 Ptd. oz. 81° 42½° NE ¼ N 1.3	10½ 626 Ptd. oz. 81° 39° NE ¼ N 1.3		
¾ oz. ° ½°								
¼ oz. ° ° 2.3	3 535 Glob. oz. 84° 40° NNE 2.3	2⅞ 605 Glob. oz. 84° 39° NNE 2.3	3½ 729 Glob. oz. 84° 38½° NNE 2.3	4¾ 959 Glob. oz. 83° 38° O.	4¾ 1189 Glob. oz. 83½° 37½° O.	9 1288 Glob. oz. 83½° 37½° O.	7 1351 Glob. oz. 83½° 37½° O.	5⅞ 1406 Glob, oz. 82½° 37 O.

.——From Cape Hatteras to Lat. 34° 37′ N.; Long. 75° 17′ W.

	4 30	5 116 S. brk. Sh. 82° 48½° SW 0.7	2⅞ 189 Glob. oz. 82½° 45° SW 0.7	3¼ 678 Glob. oz. 82½° 39° SW 0.7	2 999 Glob. oz. 82° 38½° SW 0.7	3 1309 Glob. oz. 82° 38° SW 0.7	3 1361 Glob. oz. 83° 37½° SW 0.7	

Ptd. oz.—Pteropod ooze.

ed by direction and force of the wind.——J. R. B.